



UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
DEPARTMENT OF BIOLOGICAL SCIENCES
COURSE OUTLINE

1. **Course: CMMB 545 – PETROLEUM MICROBIOLOGY**

Lecture Sections: L01 MWF 11:00-11:50 SA 124A WINTER 2018
Course Coordinator: Dr. L. Gieg
Instructor: Dr. L. Gieg BI 228A 210-7207 lmgieg@ucalgary.ca
Dr. C. Hubert EEEL 509E 220-7794 chubert@ucalgary.ca

D2L: CMMB 545 L01 (Winter 2018) Petroleum Microbiology
Biological Sciences Department BI 186; (403) 220-3140; biosci@ucalgary.ca

2. **PREREQUISITE(S):** CMMB 343 or Consent of the Department
See section 3.5.C in the Faculty of Science section of the online Calendar
(<http://www.ucalgary.ca/pubs/calendar/current/sc-3-5.html>)

3. **Grading:** The University policy on grading and related matters is described sections F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Midterm 1	28%	(February 7, in class, lectures 1-12)
Midterm 2	28%	(March 19, in class, lectures 13- 25)
Quizzes (2)	14%	
Term Project	30%	

Each piece of work (Special Project, Midterm tests or Quizzes) submitted by the student will be assigned a percentage score. The student's average percentage score for the various components listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade.

Letter Grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D
Min. Percent Required	92	85	80	77	73	70	67	63	60	55	50

4. **Missed Components of Term Work:** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in Section 3.6. It is the student's responsibility to familiarize himself/herself with these regulations. See also Section E.6 of the University Calendar

5. **Scheduled out-of-class activities:** There are no out-of-class activities scheduled for this class.

6. **Course Materials:** No text required

Useful Resources – In library and/or available on-line through U of C library system:

- Petroleum Microbiology, Eds. B. Ollivier & M. Magot, ASM Press, Washington, DC, 2005. (available in hard copy and online)
- Handbook of Hydrocarbon and Lipid Microbiology, Eds. K.N. Timmis, T.J. McGenity, J.R. Van der Meer & V. De Lorenzo, Springer, 2010. (online only)

Any other recommended readings will be available online, with links provided in lecture notes.

7. **Examination Policy:** Calculators are allowed for examinations (programmable calculators or portable computers are not allowed). The use of wireless devices, such as cell phones, PDAs (Palm OS or pocket PC devices etc.), and camera devices during the examination will not be allowed. Students should also read the Calendar, Section G, on Examinations.

8. **Human studies statement:** See [Section E.5](#) of the University Calendar.

ETHICS IN THE BIOLOGICAL SCIENCES

Studies in the Biological Sciences involve the use of living and dead organisms. Students taking laboratory- and field-based courses in these disciplines can expect involvement with and experimentation on such materials. Students perform dissections on dead or preserved organisms in some courses. In particular courses, students experiment on living organisms, their tissues, cells, or molecules. Sometimes field work requires students to collect a variety of living materials by many methods, including humane trapping.

All work on humans and other animals conforms to the Helsinki Declaration and to the regulations of the Canadian Council on Animal Care. The Department strives for the highest ethical standards consistent with stewardship of the environment for organisms whose use is not governed by statutory authority. Individuals contemplating taking courses or majoring in one of the fields of study offered by the Department of Biological Sciences should ensure that they have fully considered these issues before enrolling. Students are advised to discuss any concern they might have with the Undergraduate Program Director of the Department.

9. OTHER IMPORTANT INFORMATION FOR STUDENTS:

- (a) **Misconduct:** Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under [Section K](#). Student Misconduct to inform yourself of definitions, processes and penalties.
- (b) **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on [assembly points](#).
- (c) **Student Accommodations:** Students needing an Accommodation because of a Disability or medical condition should contact Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities available at http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf.

Students needing an Accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to the Associate Head of Biological Sciences, Dr. H. Addy by email addy@ucalgary.ca or phone 403 220-3140.

- (d) **Safewalk:** Campus Security will escort individuals day or night (<http://www.ucalgary.ca/security/safewalk/>). Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.
- (e) **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPPA). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information see also <http://www.ucalgary.ca/secretariat/privacy>.
- (f) **Student Union Information:** VP Academic Phone: 220-3911 Email: suypaca@ucalgary.ca.
SU Faculty Rep. Phone: 220-3913 Email: sciencerep@su.ucalgary.ca; Student Ombudsman
- (g) **Internet and Electronic Device Information:** You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.
- (h) **U.S.R.I.:** At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses (www.ucalgary.ca/usri). Your responses make a difference - please participate in USRI Surveys.

Department Approval _____ ORIGINAL SIGNED _____ Date _____
M545 co W18; 12/18/2017 10:10 AM

Tentative schedule of lecture topics (*subject to change*)

1. Jan. 8	LG	Introduction to the oil industry and petroleum microbiology
2. Jan. 10	LG	What is petroleum? How is oil classified? Hydrocarbon classes & structures
3. Jan. 12	LG	How is oil formed? Diagenesis and biomarkers
4. Jan. 15	LG	Oil reservoirs, oil recovery & refining
5. Jan. 17	LG	Generation of heavy oil/Biodegradation in oil reservoirs I
6. Jan. 19	LG	Generation of heavy oil/Biodegradation in oil reservoirs II
7. Jan. 22	LG	General microbial principles – anaerobes I
8. Jan. 24	LG	General microbial principles – anaerobes II + mass balances
9. Jan. 26	LG	Determining/enumerating microbes in oilfields I
10. Jan. 29	LG	Determining/enumerating microbes in oilfields II + Quiz 1
11. Jan. 31	LG	Hydrocarbon biodegradation pathways, aerobic
12. Feb. 2	LG	Hydrocarbon biodegradation pathways, aerobic/anaerobic
13. Feb. 5	LG	MEOR I

Feb. 7 Midterm 1 – in class – lectures 1-12

14. Feb. 9	LG	MEOR II
15. Feb. 12	LG	MEOR III
16. Feb. 14	LG	Bioremediation I
17. Feb. 16	LG	Bioremediation II

Feb. 19-23 Reading Week - no classes

18. Feb. 26	LG	Bioremediation III
19. Feb. 28	LG	Bioremediation IV
20. Mar. 2	CH	Bioremediation V
21. Mar. 5	CH	Exploration – Spores I
22. Mar. 7	CH	Exploration - Spores II
23. Mar. 9	CH	Exploration - Spores III/Oilfield souring and treatment I
24. Mar. 12	CH	Oilfield souring and treatment II
25. Mar. 14	CH	Oilfield souring and treatment III
26. Mar. 16	LG	Microbiologically influenced corrosion I

Mar. 19 Midterm 2 – in class – lectures 13-25

27. Mar. 21	LG	Microbiologically influenced corrosion II
28. Mar. 23	LG	Microbiologically influenced corrosion III
29. Mar. 26	LG	Microbiologically influenced corrosion IV
30. Mar. 28	LG	Microbiologically influenced corrosion V + Quiz 2

Mar. 30 Good Friday – no classes

31. Apr. 2		Grad student lecture
32. Apr. 4		Group Project Presentations
33. Apr. 6		Group Project Presentations
34. Apr. 9		Group Project Presentations
35. Apr. 11		Group Project Presentations
36. Apr. 13		Final overview and individual project due

LEARNING OUTCOMES

From Calendar: This course will provide a comprehensive overview of microbial communities found in petroleum-associated environments, their metabolic capabilities under aerobic and anaerobic conditions, and their beneficial and detrimental impacts on the petroleum industry. Topics will include oilfield souring and treatment, biocorrosion, biodegradation in petroleum reservoirs, microbially-enhanced oil recovery, bioremediation of hydrocarbon-contaminated sites, genomics of petroleum systems, biotechnological upgrading of petroleum, and oil sands tailings pond microbiology.

At the end of this course, students should be able to:

1. Explain the composition of crude oil, how crude oil is classified, how crude oil reservoirs are formed over geological time, and how oil recovery and refining works.
2. Describe the kinds of microorganisms (and their basic physiologies) that can be found in petroliferous reservoirs, the various ways by which they can be identified, and how their activities can lead to the formation of heavy oil.
3. Describe the main metabolic pathways for the aerobic and anaerobic biodegradation of hydrocarbons.
4. Explain bioremediation, the various approaches that can be used (natural versus engineered) to clean up hydrocarbon-contaminated environments, and the numerous tools that can be used to monitor for evidence of bioremediation.
5. Describe how microorganisms can be used to enhance oil recovery (microbial enhanced oil recovery, MEOR).
6. Explain oilfield souring, and the various microbial-based approaches that can be used to control souring.
7. Understand the microbial processes that can lead to the corrosion of steel surfaces within petroleum industry infrastructure (microbial influenced corrosion, MIC).
8. Explain how Alberta's oil sands are recovered, the environmental issues associated with the oil sands industry, and how microorganisms play a role in the management of oil sands tailings ponds.
9. Through a group project, communicate a topic or seminal scientific paper related to petroleum microbiology through either an oral presentation or a poster presentation.
10. Be able to read and comprehend media reports and literature associated with the petroleum industry as presented in the media.